

Proceedings from
a series of regional seminars
on microelectronics in the
wood products industry.

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Forintek Canada Corp.
presents

***How to Introduce Electronic Based
Technology into Wood Product
Manufacturing Facilities***

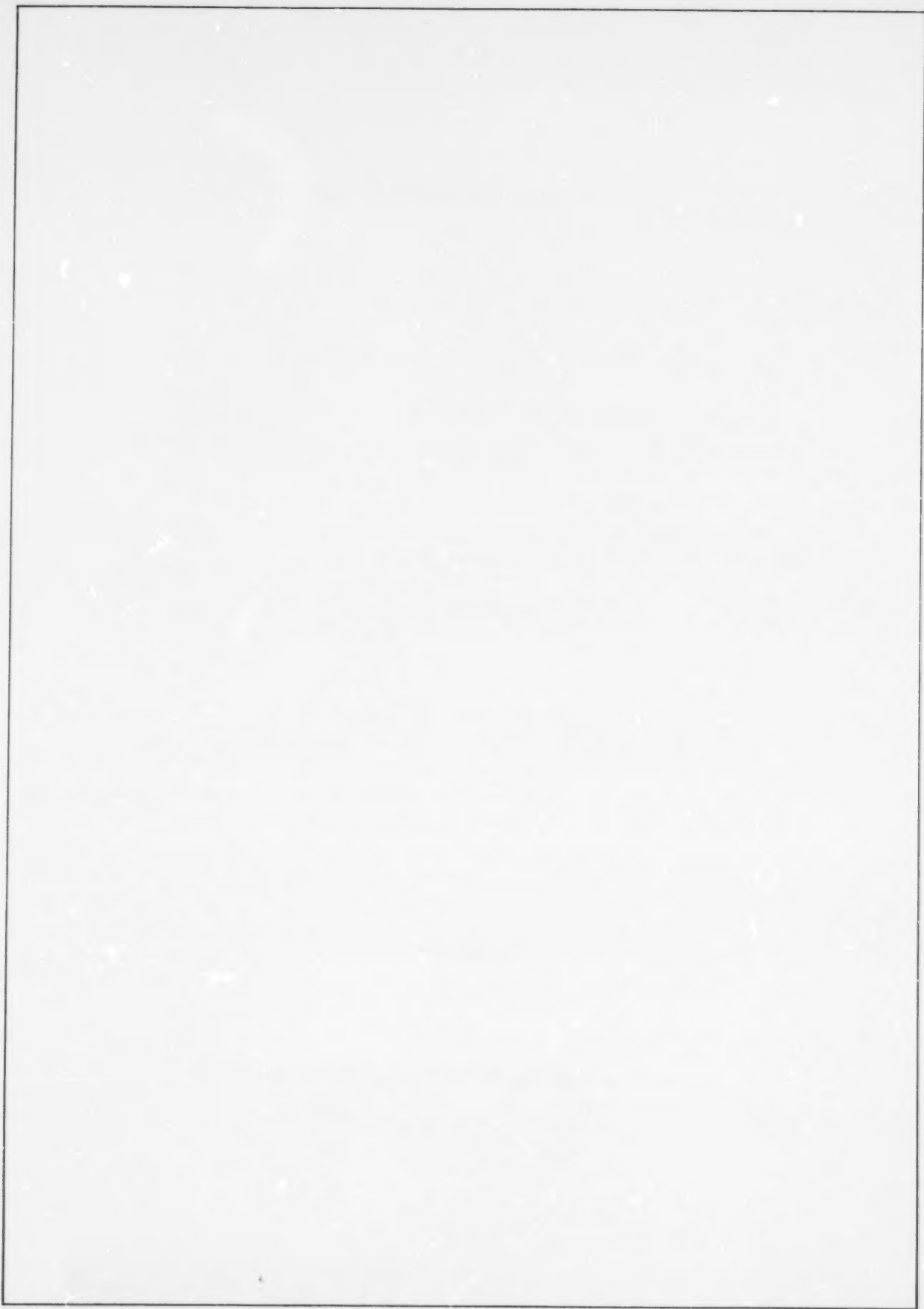
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Contents

Foreword	5
Opening Remarks	6
The Need to Update Canada's Wood Products Manufacturing Facilities	8
Room for Improvement in the Sawmilling Industry	15
How to Zero-In on the Most Appropriate Areas for Conversion to Control by Electronic-Based Technology	23
Overcoming the Problems Associated with Conversion to Control by Electronic-Based Technology	26
How to Introduce Electronic Based Technology into Wood Product Manufacturing Facilities	29
Question Period	35

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Foreword

R. W. Stephens

"How to introduce electronic based technology into wood product manufacturing facilities" was designed as the introduction to a series of seven regional seminars which will address opportunities for improving productivity through the use of microelectronics. These seminars, presented by Forintek Canada Corp, are sponsored under the Industrial and Regional Development Program of the Federal Department of

Industry, Trade, and Commerce and Regional Economic Expansion.

On behalf of the federal government, Forintek Canada Corp. wishes to thank all those who participated in the seminar in Ottawa on September 15, 1983. We are particularly grateful to the guest speakers for their excellent contributions and to the organizers of the Forest Industry Equipment Exhibition for the provision of seminar facilities.

* * *

Opening Remarks

*M.R. Clarke
Forintek Canada Corp.
Vancouver, B.C.*

On behalf of Forintek, Canada's national wood products research institute, I would like to welcome you to the first of a series of seminars on Improving Productivity Through Microelectronics.

The need for improved productivity in our industry was recently highlighted in the first report of the Forest Industries Advisory Committee. This committee, which comprises leaders of management and labor within our industry, was set up last April to advise government of industry concerns. The first report, which was issued in August, does this and the advice has implications for provincial governments and the industry itself.

It emphasizes that the Canadian industry must take a hard look at its cost structure to remain competitive in world markets and must continue with technological change, despite the severe dislocation in manpower that results.

Tougher competition from exporters in the United States, Europe, South America, Asia and Africa is projected over the next two decades.

It points out that world wide technological developments in manufacturing are stimulating forest products investment elsewhere in the world — burying the notion that our vast softwood forests will assure Canada of continuing dominance in forest products.

It forecasts wood supply constraints as Canada reaches the limits of forest industry growth based on the natural forest.

Finally, it emphasizes that there will be no fibre shortage world wide, despite a projected growth in demand of 50 per cent by the turn of the century.

Clearly our industry faces a period of great difficulty and great opportunity over the next two decades. Our mills must increase the yield of product per log, maximize the value of product per log and minimize costs by upgrading productivity.

The most powerful tool we have to meet these objectives is 'microelectronic technology' such as the computer, the microprocessor and the programmable logic controller.

Over the long history of wood processing, computer control is a latecomer, only appearing on the scene over the past two decades. Development over that period has been remarkable, but what is even more remarkable is that the rate of development is accelerating. Some of the technology available today was not conceived five years ago.

In the sawmilling industry, electronic controls are available which can scan a piece of wood, determine its characteristics, orient it for best recovery, hold it securely and transport it through the saw system at its proper cutting speed. Electronic controls have been developed to control every aspect of processing from log bucking through breakdown, trimming, edging, sorting, drying and packaging.

We are now moving into a phase where computer controlled machine centers are being integrated with master computers which address management needs from marketing to quality control to shipping. At the same time developments in such technology are resulting in systems which are more compact, more reliable, easier to use, and lower in cost. These trends will continue.

This seminar will address the question How to Introduce Electronic Equipment. We will first take a

look at the broad economic factors affecting our industry. We'll focus on specific areas in the mill where improvements can be made. We'll hear some of the problems and benefits experienced by mills which have introduced the technology and we'll look ahead to where that technology is going.

We are following up this seminar with seven more seminars where specific regional concerns of management and labor are addressed. These seminars are being presented by Forintek, as with this one, in cooperation with the regional industry associations

and will be held in the major manufacturing centers across the country.

The seminars are sponsored by the Federal Department of Industry, Trade and Commerce and Regional Economic Expansion under a federal initiative called the Industrial and Regional Development Program. This program is designed to encourage investment, develop new products, increase productivity particularly through innovation, and enhance the competitiveness of Canadian industry.

* * *

The Need to Update Canada's Wood Products Manufacturing Facilities

Albert Schuler
Forintek Canada Corp., Ottawa, Ontario

There have been recent concerns by government and industry that the Canadian wood products industry must increase productivity if it is to remain competitive in world markets. Maintaining competitiveness is extremely important for Canadian producers due to our heavy reliance on international trade. For example, Canada exports 70 per cent of its softwood lumber production accounting for approximately 45 per cent of all international trade in softwood lumber. In addition, Canada supplies approximately 27 per cent of the world's market pulp and 37 per cent of the newsprint used in the non-communist world. We also ship half of our waferboard to the United States.

We have investigated these concerns and have attempted to provide some insight on why productivity is now a major concern in a country, that historically has been the dominant force in a scarce resource. This report will emphasize solid wood products; however, due to the complimentary associations with the pulp and paper sector, the latter industry will receive some treatment.

Supply / Demand Considerations

Demand

Recent studies (1, 2) indicate that world demand for forest products will increase by two to three per cent per year in the next 20 years—three per cent in the pulp and paper sector and one per cent in solid wood products. Although this is considerably less than increases in the previous 20 years, it still represents a 50 per cent increase by the turn of the century.

Looking more closely at solid wood products, the softwood lumber demand picture is not as promising. World demand is expected to grow by a modest nine per cent by 1990 over 1979 levels—less than one per cent per year. Residential housing, the largest single user of softwood products, is expected to decline

substantially during the 1990's, largely due to demographics in North America. Canadian housing starts are projected to decline to the 150,000/year level and U.S. starts will decline to an average level of 1.4 million/year during the early 1990's. However, most observers feel that these declines will be fully offset by increases in industrial uses (packaging, panelling, pallets, etc.) and the rapidly growing home renovation market in North America.

Looking more closely at the U.S. housing market, major declines will occur in the north east and north central states as Americans relocate in the south and southwestern regions in response to migratory trends and economic problems such as those facing the auto and steel industries. Canadian mills will face increasing competition from U.S. suppliers in servicing the southern growth area.

On the brighter side, Japanese imports of Canadian lumber are expected to increase from 1.1 billion BF to 1.8 billion by 1990; however, there will be increasing competition from the United States and other suppliers. European demand for Canadian lumber is expected to remain relatively stable in the next decade with the U.K. remaining the major market.

Regarding the softwood plywood industry, most projections show demand to increase in U.K., Western Europe, Scandinavia, and Japan. However, Canada will again face increasing competition in Europe and Japan from U.S. suppliers.

Physical Supply

Softwood sawlog supply is projected to increase by five per cent (non-communist world) by 1990 - less than one per cent per year. Major new sources will be Latin America, Oceania, Africa, the Middle East and S.E. Asia. Softwood lumber production will remain relatively stable in the next decade. Canada will increase production to 21 billion board feet by 1990,

an average annual increase of 1.4 per cent. U.S. lumber production is expected to return to 1979 levels (40 billion BF) and increase slightly by 1993. Lumber supply from Europe and Scandinavia will increase little, if at all.

There will be major increases in softwood lumber supply from New Zealand, Chile, and South Africa by late 1990's. These increases will occur as major plantation timber matures.

Economic Supply

Although physical supply is projected to match total demand (as it must), it is the delivered cost of timber that will have a major impact on allocating market share of the world demand. Canada has enjoyed historical economic advantage over international competition due to an abundance of natural timber. However, future world supply and demand will be more closely in balance and this means that suppliers with lower delivered wood costs will have a competitive advantage.

Canada's forest sector is entering a critical period of transition. The old growth stands are becoming less accessible and recovery costs are escalating. Similarly, existing natural stands have lower density and quality of timber, hence the value of timber harvested per land area is declining. Eventually, Canada will have to shift from an old growth timber-based economy to a managed second growth economy. However, this will take years because Canada has been very lax in her forest renewal program.

Canadian production costs are projected to increase at a two to three per cent annual real rate while costs are expected to remain relatively stable in Europe and to rise only slightly in the U.S. Higher harvesting costs, lower wood quality and diminishing supplies in Canada vis-a-vis the rest of the world are major contributing factors.

Canada will also face increasing competition at world market levels due to product substitution (composites for conventional lumber and panel products); intermediate and end-use product differentiation and shifts in the domestic forest policies of our major trading partners. The U.S.A., Scandinavia and Western Europe have relatively active forest renewal programs in place and, according to a recent report from the U.S. Office of Technology and Assessment, the U.S. may soon be in a position to be a major force in international wood product markets. Other factors include the proliferation of tariff and non-tariff barriers to trade.

Recent Productivity Trends

Cost competitiveness will be a prerequisite for economic survival in world wood product markets in

the future. Canada will have to put relatively more emphasis on productivity in converting trees into wood products, simply because our production costs will be higher than most of our competitors and there will be tougher competition in all of our traditional markets around the world. We will have to find ways to compensate for higher relative wood costs, at least until our second growth forests are economically mature.

Labor Productivity

Recent labor productivity trends in Canada indicate that two sectors—saw and planing mills and veneer and plywood mills—are now more productive than the all manufacturing average (Fig. 1). This has been due largely to the introduction of labor saving technology in these industries.

Examples of ongoing developments are computer-controlled log handling and sorting systems; electronic scanners and computer system control of sawing, peeling, clipping, and drying operations; automation of finished lumber sorting and semi-automatic assembly lines in plywood.

These developments are, by the way, a complete reversal of the pre-1970 era when the forest products sector traditionally lagged behind the aggregate of non-agricultural industries in terms of productivity increases (3). For example, during the period 1961-69, labor productivity increased 3.9 per cent per year in manufacturing industries whereas only three per cent and 1.4 per cent increases were registered in the sawmilling and pulp and paper industries respectively.

A major difference between the U.S. and Canadian forest industry is that the American pulp and paper industry has made the most significant increases in labor productivity in the past decade (Fig. 2). In fact, the American pulp and paper industry is now the lowest cost producer in the world for major grades of market pulp. The veneer and plywood industry has also made significant gains, but there have been no such gains in the saw and planing mills.

Although labor productivity has been increasing in parts of the Canadian solid wood products industry, real unit labor costs have also been increasing (Fig. 3), particularly in the saw and planing mill sector. This means essentially that labor costs have been increasing faster than productivity increments. Conversely, unit labor costs in Canadian veneer and plywood mills have not increased as much in real terms over the past decade.

A look at similar developments in the U.S. indicates that unit labor costs for sawmills and planing mills have increased less than their Canadian counterparts

and unit costs in veneer and plywood mills have actually dropped by 20 per cent since 1965.

Comparing labor productivity on a world-wide basis, we see that Canada leads the world in physical labor productivity for the aggregate solid wood products industry (Fig. 4). We have twice the productivity of Norway and the U.S., and 1-1/2 times that of Sweden and Finland in terms of M³/man-hour.

However, when we look at changes in productivity over time as measured by indices, we see that the Scandinavians are making great strides in improving productivity (Fig. 5), particularly during the period 1975-1980. Productivity increments in both Canada and the U.S. aggregate solid wood products industry have flattened out during the period 1977-1980.

Other Productivity Measures

Labor productivity is only one component of cost competitiveness. Capital productivity as measured by output per current value of capital assets is an integral component, yet it is very difficult to measure. Capital productivity represents a measure of the current level of conversion technology. Therefore, we can use conversion factors as a proxy for capital productivity. Conversion factors represent input of wood raw material required to produce a given level of finished wood product.

In the conversion efficiency category (Table 1), we see that Canada is the least efficient producer (world-wide) of hardwood lumber products. In addition, we are among the least efficient producers of softwood lumber and plywood products. The relatively high figure in the sawn softwoods column for the U.S. is misleading because production was based on actual dimensions whereas all others are based on nominal dimensions. The comparable U.S. figure is in the 1.85 - 1.95 range. Conversely, Canadian mills producing particleboard and fiberboard (waferboard) are the most efficient in the world.

These conversion figures are an indication that Canada is now having difficulty in converting smaller and lower quality raw materials into lumber and plywood products. In addition, many of our western mills are old and not geared to the available resources. On the other hand, the Canadian composite product facilities are relatively new and represent the latest technology available.

Future Concerns

Although physical labor productivity has been one of the bright spots for the Canadian forest products industry, there are other factors involved in determining cost competitiveness in world markets. Conversion efficiency, raw material costs and wage

rates are all part of the picture. We have already discussed future problems with raw material costs, but there are other interesting developments that will impact on Canada's ability to compete in world markets.

We already mentioned that conversion efficiency leaves much to be desired in the softwood and hardwood lumber sector and in the plywood sector. There are indications that Canada will fall further behind, technology-wise, if research and development expenditures are any indication of future levels of technology. As seen in Fig. 6, we have historically spent less on R & D than our major competitors. The U.S. spends four times as much as Canada, Sweden three times as much, and Norway and Finland spend relatively more than we do.

Canada has some very serious labor/management problems. Historically, Italy has had the worst strike record in the western world; however, if we look at recent trends for 1980-82, Canada is now in the unenviable position of having the worst strike record (Table 2).

Looking more closely at individual sectors, we see that forestry is the third highest in days lost per union member (Table 3). Coupled with this poor strike record are recent trends in wage settlements that have Canadian forest sector wage rates increasing faster than their American counterparts.

Our major competitors are investing considerable effort in intensive forest management. There has been a significant increase in plantation forests in the United States, Scandinavia, Western Europe, Japan, South Africa, Australia, New Zealand and South America. The U.S. south, for example, is now working on their "Third Forest" while Canada is just beginning to initiate policies and programs to increase forest productivity. The major emphasis of recent programs has been on forest renewal; however, complementary programs in forest protection, supply of trained manpower, education and training facilities and research are needed.

Productivity is something that we are going to have to address to carry us over this interim period until we get to the point where we can start relying on the lower cost second growth forest. We are going to have to figure out ways of staying competitive during this interim period and productivity increases are the best way to achieve this. We are going to have to deal with higher relative production costs and this means that we are going to have to increase productivity. Microelectronics is one way that we can do this in order to increase our conversion efficiency and to extend the resource itself. In other words we have to increase utilization and also increase our total productivity — thus reducing unit costs.

So microelectronics has a major role to play and we are going to have to spend more time and effort on increasing productivity than the rest of the world if we want to try and hold onto our markets.

Conclusions

Cost competitiveness will be the key to future survival in world wood products markets. Although world demand is projected to increase by 50 per cent by 2004, there will be an abundance of world forest biomass, particularly from countries that Canada trades and competes with. Canada will no longer be the dominant force in the scarce resource, but simply a major participant in an increasingly competitive environment.

Being cost competitive means addressing the productivity aspects of labor and capital inputs, conversion efficiency, labor costs, and raw material costs, i.e. total production costs. There are some strong indications that Canadian production costs vis-a-vis the rest of the world will be high for the following reasons.

- Delivered wood costs will increase faster in real terms because we are still relying on an increasingly inaccessible and lower quality old growth resource.
- Recent wage rate settlements and our poor labor / management relations mean higher unit labor costs.
- Technology levels in Canada may well be lower because our competitors are spending more on R & D.

- Our competitors are investing considerable effort in intensive forest management (plantation forestry), while we are still talking about the "possibility" of running out of natural timber.

Canada must put relatively more emphasis on productivity gains to carry us through the transition period of relying on natural timber to relying on second growth stands. We must find ways to compensate for higher relative production costs in the interim period. This means a concerted effort by government, industry and labor to work together. Increased productivity is the key — both in the forest and in the mills.

If we do not remain cost competitive, we will lose market share and this will be translated into lost jobs and income for Canadians. In addition, cost competitiveness is necessary to maintain an attractive investment climate which has a direct impact on capital spending, and thus on productivity.

Literature Cited

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2. U.S. Office of Technology Assessment. 1983. Wood Use - U.S. Competitiveness and Technology. Congress of the U.S.A., Office of Technology Assessment, Washington, D.C.
3. Sandoe, M. and M. Wayman. 1977. Productivity of Capital and Labor in the Canadian Forest Products Industry, 1965 - 1972. Can. J. of For. Res. 7:85-93.

* * *

Table 1
Conversion Factors Relating Input of Raw Material to Output
(m³ solid wood volume in the rough / m³ production)

COUNTRY	END PRODUCT				
	Sawn Softwoods	Sawn Hardwoods	Particle-board	Plywood	Fibreboard
Finland	1.93	1.68	1.24	2.94	1.41
Norway	1.97	—	1.48	—	1.61
Sweden	2.00	1.84	1.48	2.54	1.74
Canada	2.05	2.26	0.96	2.71	0.79
U.S.	2.61*	2.09	1.45	2.22	0.80

* Production based on actual dimensions, all others are based on nominal dimension.
Source: F.A.O. Conversion Factors for Forest Products.

Table 2
Days Lost Per 1000 Employees (Yearly Average)

	1973 - 1982	1980 - 1982
Canada	914	834
Italy	1,211	752
Australia	705	730
Britain	471	374
United States	396	267
West Germany	40	9

Source: **The Financial Post**, August 27, 1983, p. 1.

Table 3
Days Lost Per Union Member by Industry, 1973 - 1982

	Days Lost Over Decade	Percent National Average
Fishing	138	475
Mining	118	421
Forestry	46	164
Finance	43	153
Construction	42	150
Manufacturing	40	143
Agriculture	33	118
Transportation	22	78
Trade	15	64
Service	12	42
Public Administration	9	32
All Industries	28	

Source: **The Financial Post**, August 27, 1973, p. 2.

Figure 1.
LABOUR PRODUCTIVITY IN THE
CANADIAN FOREST INDUSTRIES
1965 - 1981

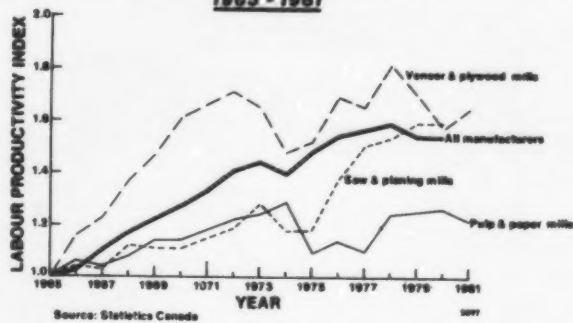


Figure 2.
LABOUR PRODUCTIVITY IN
THE U.S. FOREST INDUSTRIES
1965 - 1981

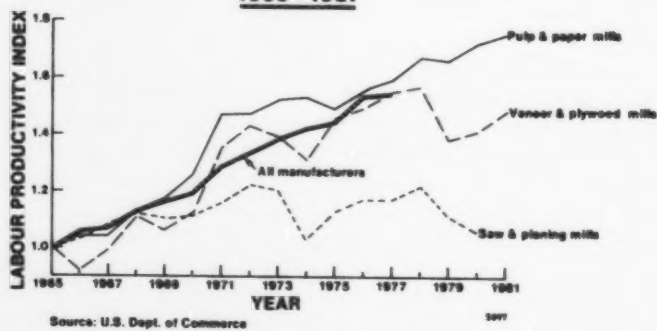


Figure 3.
INDICES OF PRODUCTIVITY AND UNIT
LABOUR COSTS - CANADA (costs in 1965 funds)

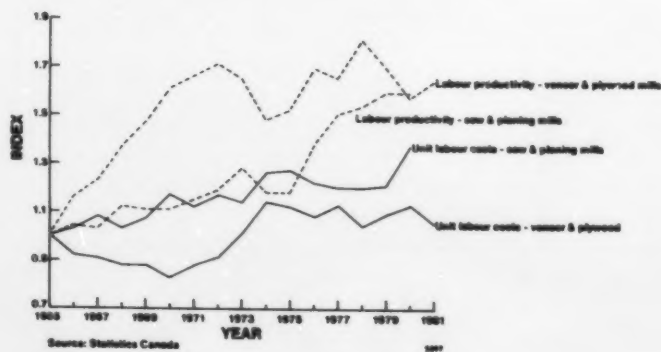


Figure 4.
LABOUR PRODUCTIVITY IN SOLID
WOOD PRODUCTS* (m³ per man hour)

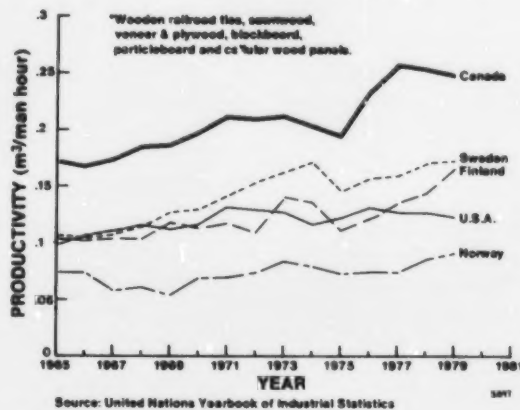


Figure 5.
LABOUR PRODUCTIVITY INDICES
IN SOLID WOOD PRODUCTS*

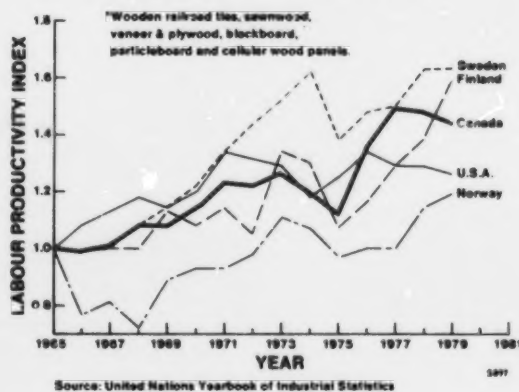
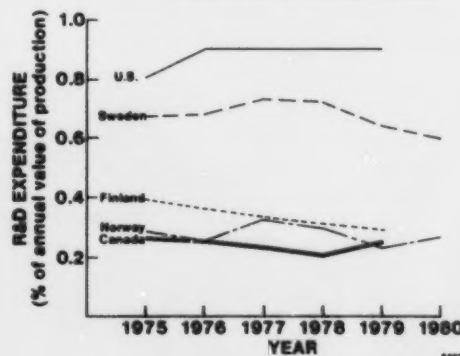


Figure 6.
RESEARCH AND DEVELOPMENT EXPENDITURES
BY GOVERNMENT AND INDUSTRY
IN WOOD BASED INDUSTRIES



Room for Improvement in the Sawmilling Industry

*Bill Love, Sawmilling Specialist
Forintek Canada Corp., Ottawa, Ontario*

We — and I am speaking now for the sawmilling group at Forintek — feel that profitability at each and every sawmill can be improved with little or no major capital investment. There are some very good mills out there, but there is always room for improvement. This paper sets out to identify those areas we have found in our work where improvement can be made in most mills. We, as a sawmilling group, have studied 62 individual log breakdown systems in 47 different sawmills under our Sawmill Improvement Program (SIP). At this point, I will outline some background on this program for those who may not have heard of it.

The SIP program was originally initiated by the Eastern Forest Products Laboratory of the Federal Government and was expanded in 1979 following the formation of Forintek. The objective of this program has been to identify areas where improvements could be made to an existing operation. As well, we try to estimate the benefits associated with these recommendations so that improvements with the greatest financial return are easily identified. In the past, many of these improvements would require additional manpower and capital.

Today, however, the diminishing cost of process control equipment and its adaptability make it a great tool for improving any existing operation. I would like to look at some examples from the work we have done to illustrate where there is room for improvement. These examples involve improvements in productivity or recovery because they are one and the same when you get to the bottom line.

We have identified five major areas where we feel there is usually room for improvement in an existing operation. We call this the Road to Improved Recovery and Productivity.

As you can see, the five areas are:

- Improving Log Quality
- Improve Log Allocation
- Optimize Log Breakdown
- Minimize Lumber Size
- Improve Productivity

All five have a significant effect on the overall profitability of the sawmill. Improvements can be made in each of these areas with little or no capital investment.

Improving Log Quality Entering Mill

Here we are talking about all the operations which affect the log before it is actually processed. These operations are important because any efforts here can't be corrected in the mill. Slashing has a tremendous impact on the final product yield. Poorly slashed logs invariably result in reduced recovery and productivity. The important points to consider in checking log quality coming into your mill are:

- sweep
- crook
- log length
- overlength
- debarking

The first two, sweep and crook, we all know are a problem in that they reduce recovery and productivity. Computer controlled bucking systems should reduce this problem in the future. The other three points are:

- log length
- overlength
- debarking

These are less obvious but shouldn't be overlooked as they affect profitability. How much? Well, let's have a look at an example considering the first two, log length and overlength. Just so we are talking about the same thing, let me define what we mean by log length and overlength.

- Log length: here we are speaking of producing the correct log length for the lumber sizes marketed. In other words, producing the correct nominal length log plus the minimum trim allowance required.

- Overlength: is any length in excess of the sum of the nominal log length plus the required trim allowance.

To illustrate what we mean, we have the case of the mill selling lumber on the even foot (8-10-12-14-16). Measuring the logs we find a log cut 12 feet 9-1/2 inches. In this case, the log should have been cut 12 feet 5 inches. As cut, this log has 4-1/2 inches of overlength. Another log is 11 feet 10 inches; this log length is not desired. In this case, the overlength would be 11 feet 10 inches - 10 feet 5 inches 17 inches.

This is an extreme example, but logs such as this, which are bucked just short of the nominal length, are especially detrimental because lumber must be trimmed back to the next nominal length which is usually two feet. This represents 12.5 per cent on 16 foot lumber. Excessive overlength and improper log length are costly.

Firstly, lumber recovery is lower from these logs as this extra length is usually trimmed off and chipped. No additional lumber is produced from the overlength.

Secondly, this extra log length consumes expensive processing time without producing any additional lumber. This reduces throughput and increases processing cost per log.

Finally, producing the correct length initially would occasionally allow a longer last log to be cut from the tree length. It also results in a slight increase in the small end diameters of subsequent logs. Occasionally, this diameter increase will put this log in the next higher diameter sort class resulting in increased recovery. During one study, we found the trim allowance on the study logs averaged 6.9 inches if odd log lengths were acceptable. As the mill was not producing odd length lumber, our average trim allowance increased from 6.9 inches to 8.6 inches. Now, let's assume all the logs could be cut the proper length and with, say, an average trim allowance of 5 inches. The excess overlength 3.6 inches (5.0 inches to

8.6 inches) would be saved and lumber recovery would improve as shown in Table 1.

You can see that eliminating the overlength produced a 1.7 per cent increase in the Lumber Recovery Factor (LRF). What does that mean to an operation cutting 25 MMfbm/year? (Table 2).

The 1.7 per cent increase in recovery translates into the production (425 Mfbm) of additional lumber from the same sawlog resource. There is no additional resource or sawing cost associated with this additional lumber. In calculating the value, we have assumed a shrinkage and planer mill loss of six per cent. As well, we subtracted \$14/Mfbm for drying and \$26/Mfbm for planing from our selling price of \$240/Mfbm. The lumber value increase totals about \$80,000. When we subtract the value of the lost chips, we obtain a net benefit of almost \$50,000 per year.

The third point under log quality refers to debarking. A lot of money can be made or lost at the debarker. Too much bark in the chips and you lose the premium or, worse yet, the chip contract. Too much fiber removed here is lost for good. Complicating this matter is the desire to increase lumber recovery. If we increase lumber recovery, less wood fiber will end up as chips from a given tree volume. If debarking efficiency does not increase at the same time, then the relative percentage of bark will increase in the chips. There is a fine balance here between too much and not enough. If we haven't achieved this balance, how much can it cost? We used the Best Opening Face (BOF) program to simulate the effect of log diameter reduction due to excessive debarking.

A 6.4 inch diameter log, 12 feet long with two inches of taper should yield 27 fbm of lumber if the log is sound and straight. This is based on the BOF sawing solution for split taper, log and cant sawing and a 1.875 in. target size (Table 3). You can see here that if the debarker is removing a tenth of an inch too much of good fiber, that same log would yield 11 per cent less lumber. What can this mean to our operation producing 25 MMfbm per year? (Table 4)

Let's assume that we do not recover the full potential of 11% on every log. Let's assume four per cent, or say one log in three. The same logs should yield an extra 916,000 board feet of lumber. Using our net value of \$200/Mfbm to allow for drying and dressing of this additional lumber, this lumber is worth \$183,000. What the net benefit to the operation would be is very dependent on how well we can balance our bark and chips, but it is certainly worth a look. Don't forget that we only increased lumber recovery on every third log. There would be additional wood fiber on the other two logs which might be recovered as chips.

The next major area I want to discuss deals with Log Allocation. In this area, we are looking at

- yield or lumber recovery by production line;
- productivity by production line; and
- profitability by diameter.

The first two obviously involve the case of optimum allocation of sawlogs between two processing lines. This is a very important step in any two-line mill. Logs must be processed to achieve maximum overall mill recovery and productivity.

We feel, however, that log allocation is just as important in a single line mill. It is important to process only profitable logs. I would like to share two examples with you to illustrate these points.

The first example involves the two-line mill. One line was for logs less than seven inches while the other line was for the larger logs. During our study, ten per cent of the logs on the large log line were under the seven inch sorting guideline and 20 per cent of the logs on the small log line were over the seven inch sorting guideline.

The optimum allocation between the two lines is shown in Table 5.

You can see that proper allocation of logs between the two lines would increase the overall mill Lumber Recovery Factor by four per cent. Based on an annual production of 48 MMfbm, this increase would result in the production of an additional 1,930,000 fbm of lumber from the same sawlog volume (Table 6). Again, we have assumed a drying and dressing cost and allowed for shrinkage and planer mill losses in coming up with the additional lumber value of \$363,000.

There will be a loss of chip revenue but the next benefit to the operation was still calculated to be over \$200,000 as can be seen.

How about that single-line mill? If you remember, for that mill we were talking about profitability by diameter. What are the potential benefits?

These are log sizes in mills which are processed and produce no lumber. This is a very expensive way to make chips. There are also log sizes which, because of their small size, require far too much expensive headrig time per Mfbm of lumber. The result is log sizes which are processed at a loss. The production cost for these logs far outweighs the product value generated by those same logs. Table 7 shows us an example of this situation.

Before anyone gets nervous, these numbers were calculated at the bottom of the recession. Since then,

lumber prices have risen but this operation still has to process about 280 three inch diameter, eight foot logs to produce a thousand board feet of lumber. The mill did not have any more available resource. Any decision, therefore, to chip these logs would reduce annual lumber production. The result of chipping rather than sawing those unprofitable logs is shown in Table 8.

As you can see, the decision to chip those two small diameter, short length sawlogs saved enough in sawing costs to produce a net benefit of just over \$100,000 per year. This operation did not have to make any investment to facilitate chipping of these logs.

The benefits would be significantly higher, however, if larger, profitable logs could have been processed in place of those small logs which were chipped.

Optimum Log Breakdown

We all know the cost of delivered wood is rising and of the need to maximize recovery. We have already seen examples of the potential benefits available due to small increases in recovery. The important point is that the log breakdown process is only one step that affects the final yield. You could have the best computer controlled log breakdown system, but it will only be as good as the processes before and after it. Computerized headrigs are very good in that they minimize the chance of losses due to operator error. As well, it can allow management the opportunity to optimize on value which can be a big advantage in terms of marketing.

But any computerized log breakdown system will be very dependent on two important factors:

- efficiency of the scanning system;
- efficiency of diameter sorts to sawing diagrams.

Remember the 11 per cent difference in recovery at the debarking stage due to the difference in diameter? The same thing can happen at the headrig if scanning or sorting is less than ideal.

Minimize Lumber Size

What we mean here is producing the smallest possible rough, green size required to give us the final dry, dressed market size. To achieve this, we have to think about three things.

- sawing variation
- target size
- quality control monitoring

We have to establish a realistic minimum target size. Then we have to stick to it, not just for a week, but on an ongoing basis. Therefore, we need quality control. If we follow these steps, our target size should allow us to eliminate any oversizing.

Figure 1 shows what we mean by oversizing. We carry out thickness analysis to determine sawing variation. Once we know this, we start with our final market size and add to it. We add allowances for planing, shrinkage and sawing to come up with the minimum target size. The amount (either thickness or width) by which our lumber exceeds this target size is called oversizing. This additional fiber is lost as lower valued planer shavings. What we want to do is eliminate this oversizing so that this fiber may be recovered as additional higher valued chips and lumber. It is doubtful in eastern Canada that elimination of oversizing will result in the production of extra boards because of the small log diameters. However, elimination of oversizing can result in the production of longer, wider or thicker pieces of lumber.

Figure 2 shows how the elimination of oversizing increases lumber recovery. In this example, the elimination of less than 1/16 inch in the target size allowed the length of the top two by four to increase from 12 to 14 feet. This translates to a recovery gain of 2.6 per cent.

Most mills target 17/8 inch for two inch lumber; some mills go down to 1 13/16 inch, but this is about the lowest we see. With proper quality control checks and low sawing variation, we have generated some target sizes as low as 121/32 inch (1.656). Our colleagues at the Western Laboratory in Vancouver are now seeing target sizes on gang edgers and Chip-N-Saws of 111/16 inch (1.687) to 123/32 inch (1.718).

What does this mean to an eastern Canadian operation cutting 25 MMfbm a year? Let's assume that after a lumber size evaluation, the company finds they can reduce their target size from 1 7/8 inch to 1 13/16 inch. In other words, reduce oversizing by 1/16 inch. Let's also assume that only one-third or 33 per cent of this oversizing is recovered as lumber and the remaining two-thirds as chips. The benefits of this change are shown in Table 9.

Based on a production of 25 MMfbm (rough green), the reduction in oversizing would result in the production of an additional 213 Mfbm of lumber with no increase in sawlog volume. This lumber, after

allowing for shrinkage losses plus drying and dressing costs, would have a value of over \$40,000. Adding the value of the additional chips results in a total net benefit of \$68,000 annually.

My last topic is improving productivity and two factors need to be considered.

- Down time
- Delay time

Productivity is the "name of the game" and down time is crippling in terms of cost, but what I would really like to discuss is delay time. This is different from down time. Down time affects the time during a shift when a machine is available for processing. Delays, on the other hand, are short duration interruptions when the machine is available but not actively processing material due to operational or mechanical problems in the mill flow. It reduces the rated capacity of a machine, it can lead to operator frustration, and it is much harder to detect.

Because they are short duration delays, they are easily overlooked during a shift but they sure affect the total production. Delays that we have measured at the headrig have ranged from less than one per cent to over 17 per cent. Usual causes for delays at the headrig include:

- lack of material;
- log handling delays;
- log jams at unscrambler;
- surge deck overloaded downstream;
- chipper jam.

What do delays cost? (Table 10) We have assumed that we could reduce delays by ten per cent with minor modifications. This would increase production by at least ten per cent as delays only affect the productive machine time. When we amortize the sawmill operating cost over the increased production level, there is a \$7.27/Mfbm decrease in sawing cost. On an annual basis, this amounts to a \$199,925 savings. The only cost involved would be the cost of any modification.

That concludes my run through the mill. The total benefits are shown in Table 11.

You can see that some sizeable benefits are available to our operation cutting 25 MMfbm a year. A lot of these improvements require some hard work, applying a little science and lots of common sense, but there is room for improvement.

* * *

Table 1
Current Milling Conditions

	Log Volume (cf)	Lumber Tally (bf)	Lumber Recovery Factor	LRF Improvement (%)
Study Logs With Overlength	2847.2	18,222	6.40	—
Study Logs Without Overlength	2798.8	18,222	6.51	1.7

Table 2
Benefits From Reduction in Log Overlength

Annual Production	25 MMbf
LRF Increase	1.7%
Additional Lumber Volume	425 Mbf
Additional Lumber Value	\$79,900
at $425 \times .94^* (240 - [14 + 26])$	
Reduced Chip Value	\$31,700
$\frac{425,000}{12bf} \times \frac{45.6}{2000} \times \$70/ODT$	
Net Benefit	<u>\$48,200</u>

* shrinkage 6%

Table 3
**Increase in Lumber Yield
Using Correct Debarking Technique**

Log Diameter (in.)	BOF* Yield (bf)	LRF	Difference (%)
6.4	27	7.22	—
6.2	24	6.42	11.1

6.4 log
12 foot long
2 inch taper
split taper log and cant sawing
* based on a target size 1.875

Table 4
**Benefits Using Efficient
Debarking Technique**

Annual Production	25 MMbf
LRF Increase	4%
Additional Lumber Volume	916 Mmfb
Additional Lumber Value	\$172,200
at $916 \times .94^* (240 - [14 + 26])$	
Reduced Chip Value	—
Net Benefit	<u>\$183,000</u>

* shrinkage 6%

Table 5
Potential Lumber Recovery Improvement

	Small Log Line LRF	Large Log Line LRF	Mill LRF	Improvement (%)
Study Log Allocation	5.51	5.98	5.77	—
Optimum Log Allocation	5.64	6.31	6.01	4.0

Table 6
**Benefits From
Improved Log Allocation**

Annual Production	48 MMbf
LRF Increase	4.0%
Additional Lumber Volume	1,920 Mbf
Additional Lumber Value at 1,920 × .94* (240 × [14 + 26])	\$36,000
Reduced Chip Value	\$143,000
$\frac{192,000}{12\text{bf}} \times \frac{25.6}{2000} \times \$70/\text{ODT}$	
Net Benefit	<u>\$218,000</u>

* shrinkage 6%

Table 7
**Net Product Values
(\$/Mbf)**

Log Diameter Class (inches)	Log Length		
	8 feet	12 feet	16 feet
3	-215	-109	-61
4	-174	-143	-40
5	-40	13	39
6	7	37	46
7	42	57	70
8	75	—	92
9	86	—	121
10	101	—	—

Table 8
Benefit of Chipping Some Unprofitable Sawlogs*

Processing Logs for Lumber		
Annual Production	25MMbf	
Chip Production (ODT/year)	1,420	
Total Product Value (\$/year) (Lumber, Chips, Residues)	308,500	\$308,500
Processing Logs for Chips		
Chip Production (ODT/year)	2,920	
Value of Chip Production (\$/year)	225,000	
Savings in Sawing Costs (\$/year) (49 shifts)	177,600	
Savings in Planing Costs (\$/year)	20,300	
Total Value of Chipping (\$/year)	422,900	<u>\$422,900</u>
Net Benefit (Chipping)		<u>\$114,400</u>

*chipping 3 and 4 inch diameter × foot sawlogs

Table 9**Benefits from Reduction in Oversizing Lumber**

Annual Production	25 MMbf rough green
LRF Increase	1.1%
2 inch Lumber Production	80%
Additional Lumber Volume	213 Mbf
Additional Lumber Value at 213 x .94* (240 - /14 26/)	\$42,600
Additional Chip Value at 427 ODT x \$60/ODT	\$25,600
Net Benefit	<u>\$68,200</u>

* shrinkage 6%

Table 10**Benefits from Reduced Delays**

Annual Production	25 MMbf
Operating Cost (Sawmill Fixed and Variable)	\$2 MM
Sawing Cost/Mbf	\$80/Mbf
Delays	10%
Additional Lumber Volume	2.5 MMbf
Reduced Sawing Cost	
$(\$80/\text{Mbf} - \frac{\$2\text{MM}}{27.5 \text{ MMbf}})$	
Sawing Cost Savings (\$7.27/Mbf x 27.5)	\$199,925
Net Benefit	<u>\$199,925</u>

Table 11**Total Benefits for a
25 MMbf Sawmill Operation**

Elimination of Overlength	\$48,200
Improved Debarking	183,000
Improved Allocation	114,000
Minimize Lumber Size	68,200
Reduce Delays	220,000
Total Net Benefits	<u>\$633,400</u>

FIGURE 1.
THE COMPONENTS OF A TARGET SIZE

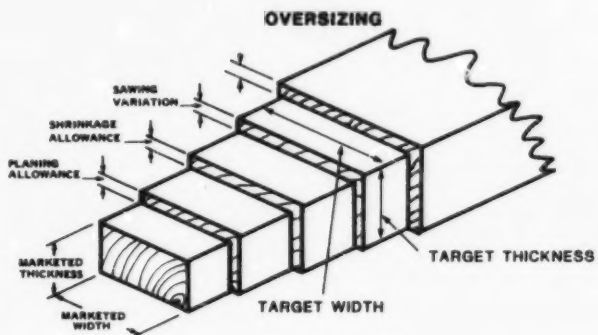
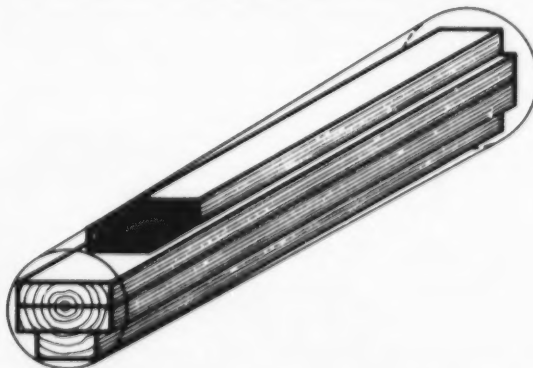


FIGURE 2.
ELIMINATION OF "OVERSIZING" OR THE REDUCTION OF LUMBER THICKNESS TO IMPROVE LUMBER RECOVERY



It is said as one moves up in the hierarchy that the manager's attention should be focused increasingly on conceptual skills and less on technical skills. By conceptual skills, I mean the ability to develop ideas. By technical skills, I mean the ability to work with methods, processes, and procedures and techniques.

How to Zero-In on the Most Appropriate Areas for Conversion to Control by Electronic-Based Technology

George Payette
E.B. Eddy Forest Products Ltd.

My subject today is how to zero in on the most appropriate areas for conversion to control by electronic based technology. Here are some suggestions: No. 1: Just don't bother, that is the easiest way. No. 2: By making mistakes, and that is a direct result of not following No. 1. No. 3: Let your competitor do it and when he has it debugged, then copy it. No. 4: Ask a salesman. No. 5: Fumble along experimenting. Should spend a lot of money that way. No. 6: Ask a consultant. No. 7: Use common sense. No. 8: None of the above, it is too complicated anyway. No. 9: Examine the problem area, define the problem you want to tackle, develop a solution, plan the work to carry out the solution, then do the work. If electronics is part of the solution, okay; if it is not, okay. No. 9 is the philosophy I intend to follow.

With regard to this philosophy, some outline of Eddy Forest Products' experiences at the Nairn Centre might be worth recording. The Nairn Centre, like many sawmill operations, started out as a portable sawmill in the early 50's sawing mining timber and ties. In 1956, the sawmill owner decided to build a permanent mill. He installed the first Cambio debarker in Canada, a chipper and an automatic carriage. We could call it an electric sawmill, and there were not many of them around especially in eastern Canada at the time. It was almost an electric sawmill but not completely. We had to put a diesel engine on the chipper because the current draw was too much for the rural hydro lines. The carriage mill

lasted until 1972 when it was replaced by chipper canters, a twin band mill and a multi-saw trimmer.

We also installed a log sorter with the CGE statistical logic control. However, the log sorter and control are long gone because they simply did not work very well. The set works on the canters and on the twin have been upgraded and the multi-saw trimmer will probably be replaced next summer.

E.B. Eddy took over the sawmill in 1973 and added a planer and a dry kiln facility. That put Nairn Centre in the lumber business as well as being in the mining timber and tie field. The planer had a Newman M712 and an Irvington Moore trimmer line with a two tray sorter. We have since added three more trays to that sorter, replaced the Irvac memory system with a programmable controller (PLC). We did not have any experience with the PLC's and it was a very good chance to learn.

The next move was the addition of a small log mill for sawing logs six inches in diameter and under, and then, at the same time, we added a sorter to that small log mill and another to the large log mill. At the time, Harvey supplied either an old ball and drum control or an electronic control. We, being progressive of course, chose electronics. I would venture to guess that Eddy Forest Products is the only company that can claim to have a system outdated before it was installed!

Another company bought a sorter at the same time as we did, probably a month later, and had it installed earlier than us. They had an entirely different electronic system which is similar to what is being used today.

We also added a tree processor and got fully into a tree length operation. Up to that time, we were strictly processing logs. The logs were brought in by rail and by truck. There are 14 saws on the processor and it is pre-programmed to different combinations of bucking. In 1977, the control cab on this processor burnt, destroying all control circuits and, believe it or not, this is the best thing that could have happened. Despite many improvements made to the original control, it was awkward and not productive. We could not maintain a 2,000 stem average per eight hour shift. Since the manufacturer could do nothing for us because of order backlog, we had to build our own. With the help of an electronic consultant engineer, we assembled a very simple electronic control with pre-programmed buttons. Two months after start-up of the home-made control, the processor was averaging better than 3,000 stems a shift.

In 1978, it was decided that perhaps process control using log scanning could improve yield and later allow us to abandon costly log sorting. Now, when I say costly log sorting, that is just what it was. We handled logs so many times, we almost wore them out. We installed a scanner controlled by a PDP-11. It was a laser scanner and it works reasonably well. The problem, of course, is that it is very sensitive to vibration and movement and if the scanner cameras move out of alignment the slightest little bit, you have to use an oscilloscope to bring them back into line. It is really a little bit too sophisticated for the mill environment.

But once we got the process control in, we felt that we could afford to get rid of the very costly log sorting and it proved that we could maintain our yield. It even improved a little bit. It was installed in 1977. In 1978, we went up to 6.12 fbm per cu. ft., we spent the whole year trying to get the thing going, and in 1979 we got up to 6.3 fbm per cu. ft.

Then one day a vice-president paid us a visit. His message for the day was as follows: "The Ministry has been informed that we intend to use the entire allowable limit cut; tree length deliveries will increase from 170,000 cunits to 242,000 cunits per year. The trees will be processed for maximum log recovery and the sawmill will be designed to handle increased output shooting for the best yield possible. Draw up a feasibility study and do not add one single man to the operation". A nice simple chore! Our problem was stated and it was defined, nothing being left for the imagination.

On that note, we began our modernization program. We have since added a second line to the large log mill. This has a scan-n-set control tied into a programmable controller. As far as I am concerned a programmable controller is the greatest recent addition to sawmill control systems. This line almost doubles the capacity of the mill, and requires the addition of only one man to operate the line. The mill had a capacity of about 111 Mfbm per shift average throughout the year. With this additional equipment, we could saw over 200 Mfbm if we could get it out. Our problem is we cannot. The trimmer will not handle the volume. Now the design capacity is 162 Mfbm per shift and in the future we will have to go to 207 Mfbm per shift because an accelerated cut has been established by the Ministry.

In the planer mill there was a stud line that put out about 50 Mfbm per shift. By buying a new Newman 990 for the random length line which is the main line, taking the 712 which was on that line and putting it on the stud line to replace an old Yates, adding a Simple Simon Gadgets Galore trimmer, retrimmer and a package-maker, the output increased to 150 Mfbm plus per shift. The manning on the line did not change. There were seven men on that line before and there are still seven men on the line. Now here is a case where we did not use any electronics at all, it was not necessary. There are two lines, a stud line and a remanufacturing line. Anything that will not make a 96 inch stud is sent to the reman line and remanufactured to something less. Our number four grade has decreased from about 17-18 per cent down to about six per cent. In other words, we are doing what a lot of the remanufacturing people are doing. There is a very simple chain transfer to the remanufacturing line manned by lumber graders.

However, when it came to strapping, Acme Steel suggested building a package doubler. The package doubler is doubling up your package one upon the other, right on the outfeed conveyor. That sounded like a good idea and they said that they would control all the functions of that unit with the strapper PLC if we would design and build it. So we went along with the idea, only we make a trippler. The set of forks was designed to stack the bundles three high on the strapper outfeed. This system has eliminated a man and a lift-truck on each of two shifts. It has made machine time so much more available to us because our driver only makes one trip where he was making six before.

The wood handling area had people and machines moving in all directions and this is probably our worst area as far as productivity is concerned. In the summertime, you could see little clouds of dust all over the place, machinery running in every direction. So, we decided to add a portal crane. We also added a very long conveyor and as a result of that, five major

pieces of the rolling stock were eliminated on a three shift basis. The saving, when you take the operating costs of the crane into account, is about \$650,000 a year just for the machinery, and of course the operators were eliminated.

The debarking system is now treelength debarking. Treelength unscramblers have also been installed at the infeed of each debarker. The debarker operator loads the trees on the infeed chain as well as operating the debarker. This eliminates three heel boom operators.

The trees are processed with an existing bush processor and a new double trough slasher. The double trough slasher is controlled with a PLC. Each tree is programmed for the cutting pattern prior to being loaded into the trough. With the double trough a 16 ft. log and an eight foot log can be cut at the same time.

There are eight programmable controllers in operation now. We did not have any a year and a half ago, but there are going to be more in the future.

We are now faced with a problem and will have to do something about it once we get all the existing equipment running properly. To define our problem we carried out an experiment. We took our 5,000 canter which is a full taper machine and sawed a bunch of logs but before we sawed the logs we measured each of them. We did it on a Saturday. Each log was measured from one end to the other, put through the scan-n-set so that it would measure and we would have a check on the accuracy of the scanner. When we had all the lumber broken down, each individual piece was measured before it was trimmed or edged. Two groups of logs were run.

The first bunch of logs averaged out to 8.1 inches in diameter and we came up with the yield of about 6.95 fbm per cubic foot. The second bunch of logs averaged at 9.7 inches in diameter and we came up with a yield of about 7.3 fbm per cubic foot. The combination of all those logs gave us a yield of about 7.1 fbm per cubic foot.

Now there is no way that we would get a 7.1 fbm per cubic foot yield. We are lucky to get a 6.1 fbm per cubic foot and, in fact, that is about what we are doing right now, between 6 and 6.1 fbm per cubic foot in that mill, which means that there is a lot of butchery going on after the lumber has had its initial breakdown and we know what that butchery is. It has to be in the edger and it has to be in the trimmer. Our

edger runs at 580 feet per minute; just think how much lumber you can destroy in an hour with that thing. The type of edger we selected will accept an edger optimizer, when we have the money for it. We already have the unscrambler, we have the lumber turner, and we have the lumber drop-out which removes the lumber that does not have to be edged. All we require now is the hardware for the optimizer and the software.

When we started our modernization program, we aimed to be at a level of 128 MMfbm, but before we got too far into the modernization program the Ministry decided that it was time to clean up the old mature timber, so they put us all on an accelerated cut. It means that we have a lot more timber that is going to have to come off the limit, and with that and a reallocation of timber from another sawmill that cannot handle the accelerated cut. Nairn operators will be sawing approximately 171 million fbm annually.

Now what that means is that the large log mill is going to be at the 100 million board foot level. If we can increase our yield from 6.1 to 6.4 fbm per cubic foot that 100 MMfbm will go up to almost 105 MMfbm.

One of the things in this high tech industry that we are getting into more and more is monitors. We have numerous television cameras and some of the control rooms look like the Global TV studio! The reason we need these TVs is because the operator's scope of work has grown well beyond his immediate visible area. So TV cameras are becoming a part of the whole operation.

Another thing that we should not forget about in this high tech game is hydraulics. We have 23 pumps in one hydraulics room alone on 10 electric motors of which seven are 75 hpw double shafted. That is a nightmare. I thought electronics was tough but hydraulics is really tough! I have been looking for a hydraulic technician and I am beginning to think that there is no such person. The above system is only one of ten in the plant.

Once again, we should identify the problem, and use the best solution, and if electronics is required, then that is the way to go. This has been our philosophy but as an old filer used to say, "don't go looking for trouble where it ain't". However, every wise man makes provision for the possible disaster. Unfortunately, the forthcoming disaster is probably not the one he had made provisions for.

* * *

Overcoming the Problems Associated with Conversion to Control by Electronic-Based Technology

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"Overcoming the problems associated with conversion to control by electronic based technology" is quite a mouthful! "How to avoid catastrophe when converting to control by electronic based technology" could be the more realistic title.

I can speak with some authority on the problems. Whether or not I can make recommendations which lead to solving them is a matter of opinion.

Since the mid-1970's, I have been deeply involved in a number of systems. Braeside Mill has installed two micro-processor controlled lumber sorting systems one for green and one for dry lumber. The planing mill also has automated trimming and lumber tallying systems for both planer lines. The number of employees was cut from 290 to 209, a reduction of 81 man years, and at the same time the productive capacity has increased by 13 per cent.

In our recently rebuilt St. Fulgence, Quebec mill, a log scanning device coupled to a micro-processor which controls the networks on the four chipping heads of a Mark 4 Chip-N-Saw was installed. A twin band resaw was equipped with an automated networks and a fully automated lumber sorting system was included in the rebuild. The number of sawmill employees here was cut from 117 to 72, a reduction of 45 man years. This mill has been operational for one and a half years and is producing 15 per cent more lumber per shift with eight per cent less degrade than the old mill.

Three equipment manufacturers were involved in the various systems. In retrospect, possibly not a very wise decision, but certainly one way of obtaining experience in the different types of systems available. We have had problems but, with only one exception, we are pleased with the results.

Start-up at Braeside occurred in the late fall of 1979. Design capacity was reached by the spring of 1981

and has steadily improved. The sawmill and dry sorter now produce 13 per cent and 21 per cent respectively over design with lost time attributed to the process-control equipment of less than one half of one per cent.

The St. Fulgence sawmill reached design capacity by the early summer of 1982 and since that time, even with a shutdown due to market conditions, has also steadily improved. Current production is 40 per cent better than our original plan. Lost time due to process-control equipment is approximately two per cent and will continue to improve. Unfortunately, our chief electrician who had been thoroughly trained developed personal problems and had to be relieved of his duties. His replacement has learned very quickly but does require more experience.

There will always be problems in converting any plant or department to electronic control. The problems a few years ago may have been mainly technical and originating at the equipment manufacturer level. In many cases, the equipment was not reliable due, in part, to the environment in which this sophisticated equipment was forced to function. Dust, vibration and low temperatures created a number of complications.

This is not the condition today. The technology to design, build and program highly complex control equipment that will withstand the rigors of the sawmill, to a degree, is readily available. Keeping it performing properly is another matter.

To a certain extent, we were 'led down the garden path' when we purchased the first systems at Braeside. We were generally led to believe that if we provided funds for sufficient technical assistance during installation and start-up, that any competent electrician could keep the systems operating with a very high degree of reliability. I suppose, in general, this is true, but we soon found that the Braeside mill

had no intention of being included in any generalization! What often happens is that 24 hours after the departure of the technician, problems begin to occur. Usually these problems are of a minor nature but this does not help when the mill is shut down and no one knows what is wrong.

In my opinion, a competent electrician can maintain the greater part of the process control equipment used in sawmills in satisfactory working order if he or she is intelligent, tenacious and sufficiently motivated to do a great deal of study on his or her own time. Even comparatively complicated problems can be corrected by telephone with the supplier's technician on the other end of the line. However, it is not quite that simple since these two people must communicate in the same technical language and both people must thoroughly know and understand the component under discussion. In our case, some of this learning experience has been very painful and frustrating, even though we consider that we are fortunate in having at Braeside probably one of the best electricians in the business.

Shortly after start-up, we engaged a computer technician to assist us in the maintenance and operation of our equipment. We found that this technician was not particularly interested in trouble-shooting electrical problems, was not comfortable working with and around high voltage and had no appreciation of the mechanical problems. We decided, at that time, to put the emphasis on training our own electrical staff, particularly our chief electrician. He attended a course in Toronto on mini-computers and the equipment supplier's technician returned to give additional instruction at our request. Since that time his primary responsibility has been the maintenance and operation of the process-control equipment. This works.

If I were to break down the technical problems in two categories, number one would be trouble-shooting and number two would be preventive maintenance.

Regarding trouble-shooting: as far as I know all systems recently designed contain a diagnostic program, and if they do not, they certainly should and the maintenance person or persons responsible for the operation of the system must be thoroughly trained in the use of this absolutely necessary tool. The number of areas, for example, in a lumber sorting system that can cause total failure of the sorter are too numerous to mention and they are not generally in the micro-processor or mini-computer. A limit switch failure, a dislocated photocell, a damaged electrical cable, or a misaligned or untimed chain can cause the complete shutdown of the sorter. Without a diagnostic program, maintenance personnel can spend hours in locating the problem and five minutes in repairing it.

Preventive maintenance and inspection programs, whether informal or detailed, are an absolute must. The inspection of all components directly or indirectly related to the process-control equipment must be maintained in "like new" condition. Spare parts must be ordered well ahead of the required time due partially to availability. Printers and computer cards must be regularly cleaned - the list goes on and on.

I have dealt with the problems on the technical side of process-control equipment and have not commented on the human side-the most important part. We must not forget that automation is not readily accepted by every part of the organization. Senior and middle management regard automation as an absolutely necessary step to staying in business, first line foremen as a pain in the butt, and workers including skilled workers as an effort by senior management to get rid of people. Even though there is no direct sabotage, the opinion that it will never work, particularly if a bad start-up is experienced, is prevalent. Not only must we do everything possible to insure that start-up due to equipment malfunction is as painless as possible, we must also insure that future equipment operators are selected carefully and that training both off the job and before start-up and on the job following start-up is well organized and controlled.

In most cases, the reduction in the labor force means the junior employees are released and senior employees are retained to operate this new mess of push buttons and controls. In organizing a training program, put yourself in the position of the employee who may never in his life have operated anything more sophisticated than his automobile. He grew up with his car and he probably thoroughly understands its operation. We now expect him to operate a piece of equipment which he does not understand, cannot see how or why it works, and which more than likely requires an extremely high degree of concentration. Furthermore, he has been told that it is worth hundreds of thousands of dollars and if he makes a mistake he can do all kinds of damage.

It is not impossible to "teach an old dog new tricks". It may be difficult but it is also difficult to teach a "puppy". We must have a lot of patience and understanding. I have often found that older employees are worth the extra effort. In my experience, it generally takes one year before operating and maintenance employees acquire the skills necessary to insure that automated equipment operates with a high degree of efficiency. Sawmills, where one machine is almost completely dependent on other machines, are prone to this problem. The weakest link determines performance.

I have outlined the problems that our company has experienced and hopefully have given some very broad guidelines in solving some of these technical

and operational problems. Unfortunately, there is another problem - that of design and selection of supplier. In the event that you are considering the use of micro-processors, mini-computers, programmable controllers, etc., you must first of all do your homework. I doubt that many eastern Canadian lumber manufacturers put enough time and energy into the selection of their equipment.

I suggest to you that you adopt the following procedure. Designate one person in your organization with the responsibility of co-ordinating the activities of everyone concerned in the new process control. Record all discussions and prepare detailed lists of requirements and expectations. Insist that each potential supplier quoting on your requirements detail their quotations with make and model of components. Obtain from the supplier a commitment on their capability of service after sale, and thoroughly investigate this claimed capability. This is essential.

Examine carefully your own ability to maintain the equipment and record your shortcomings and, finally, prepare and institute a training program.

To my knowledge, no courses or seminars have been offered to the eastern Canadian lumber industry on the application of electronics. We have courses for lumber graders, filers, millwrights, dry kiln operators, planer operators, etc., but little to offer in the operation and maintenance of process-control equipment. This task has been left primarily to the

equipment industry. They have responded but I suggest that this response has been primarily after sale and during start-up.

In general, the lumber industry does not require nor can it afford fulltime programmers, computer technicians or electronic engineers. We do require better informed management at all levels who understand and will accept the urgent need for employee participation and training in the absolutely necessary automation of our mills. We also require competent electricians with special training in the field of micro-electronics and last, but certainly not least, a co-operative labor force that understands why we must reduce the man hours per unit of production - why we must improve quality and reduce waste.

Approximately 10 or 12 months after start-up at both our mills, when planned production targets had not been reached, we held free and open discussions with all of our employees. We explained carefully where we were, where we had to be if we expected to be competitive and why we thought we could get there. We listened more than we talked and adopted some of their suggestions. Performance began to improve almost immediately.

I can assure you that the effort that must be made to develop a more highly skilled and better informed organization, proud of its accomplishments, is substantial and not without self-sacrifice. It is a very satisfying experience to observe all parts of a system, in which you may have played even the smallest part, really work.

* * *

How to Introduce Electronic Based Technology into Wood Product Manufacturing Facilities

**G.B. Wray
H.A. Simons (International) Ltd.**

Today we have to accomplish a change in the way we operate — a change greater than the Industrial Revolution. International competition, high social expectation, all kinds of reasons, but they all mean Productivity Improvement for people, nations, sawmills — productivity improvement or join the unemployed!

There are many ways to improve productivity but none offer the dramatic promise of computer-integrated manufacturing and the wood products industry stands to benefit immensely.

Define it as you will:

- The Third Wave
- The Information Revolution
- The Computer Society

The social and economic revolution foaming around us stems from that little box. To some it is a monstrous menace; to others a gentle genie. In this paper I want to show that the monster is in truth the gentle genie who will tie machine and mind together for the average wood products manager and his staff.

I am going to define some computer terms a manager must know to appreciate that a computer is not silicon chips and integrated electronic exotica. A computer is not that; it is an expansion of man's mind which will eventually enable him to comprehend the wholeness of his environment, which affects him, or his task in hand.

I say eventually. We are only beginning. I intend to use the latter part of this paper to show how man's mind and machine are already being integrated by computer in our industry.

First, let's look at the manager's mind and the complications that he has to face. The manager has to use his mind to knit together log supply, machines, people and markets to make a profit, and he has to get

effective action and reaction - information flow. Those who accuse our industry of being 10 or 20 years behind the rest of industry do not begin to appreciate the incredibly intricate and fine detail which that simple equation represents: the many decisions being made in seconds by the operator; the priorities and problems of the maintenance worker; the changes in market values; the most profitable use of varying log supplies; personnel training; absenteeism. These factors make the management task in our industry the most difficult of any I know.

We have been steadily and successfully applying computers to the machines. Scanners and computers operating machine set works are already well proven in accurate decision-making for a lot of our standard operations. Now the manager is able to know that at least some of the decisions by some of his operators are under his control. But he will not achieve total productivity improvement until that other mish-mash of information, action and reaction, is under his control.

There is no other way than the gentle giant - the Computer.

The manager will have to know computer language to make sure that his management computer programs give him the information and control to achieve the total productivity improvement he has to achieve.

Here is the language he needs to know. The computer can be:

- User-friendly
- Inter-active
- Self-teaching

I don't want to over-simplify, but I do want to stress that the manager should not be encumbered by bauds, kilo-bytes and so on which are the vocabulary of the

people who have to furnish his total computer system. They may talk in Pascal or Cobol, but the manager talks in Sawmill or Plywood. He has to ensure that the programmers and others produce programs which accurately and comprehensively represent his whole operating environment. To do this he has to truly think and act as a manager of his whole operation.

User-friendly so that his foremen, shippers, and maintenance clerks are as comfortable at a terminal as their children are at TV games. No reason why not.

Inter-active so that the information the computer asks for is immediately processed and a response right there.

Self-teaching so that all the user needs to know is there, should he need it.

The computer is not a tool for doing paper work, which is what we seem to have come to expect. It is, in fact, a tool for mental work. It should liberate the manager and his staff from routine and detail, make time and mental capacity free to seek new initiatives, to plan, to innovate and to conceive. (Fig. 1)

The computer as an extension of the mind of the manager will liberate, so the information flowing in and the evaluation performed can enable him to make decisions he needs and monitor and control for highest productivity attainable.

The manager will no longer have to be a bit of a specialist in everything he can master but, once again, a generalist who has a better grasp of his changing environment and who can change with it.

I have described our challenge and the role of the computer in making the incredibly intricate network of information to be analyzed and controlled amenable to management. Now some examples, not of the future, but of today. All this is with us now and available to bring about the next wave of man's development. The following is merely a selection of programs being provided to the wood manufacturing industry by a few of the many who are actively working to provide the tools.

I have listed some typical programs which are either immediately available or which are being developed (Figure 2). There are certainly others of which I am unaware. I am going to briefly review some of them to illustrate how they integrate machine and management.

Dynamic Control Systems

This is an example of a total machine and management control system. This machine control system consists of any number of different machine

control elements working separately to provide set works, feed speed controls, etc. linked together by a central management information computer system. Because it employs separate micro-processors, the system has the potential to permit the introduction of various adjustments to decision logic at the individual operators' consoles and yet still operate as an integrated inter-active whole. (Fig. 3)

This overall system, called here "Dynamic Optimization" by the supplier, is shown as having a more complete management information monitoring and control system imposed. This is what they call their "Mill Net System".

Consider the Dynamic Optimization system as the manager's hand, the Mill Net system as his brain.

This "Mill Net" system would most likely have its own information processing computer. Again, modular in concept, so that individual aspects can be separately added and adjusted, the various elements interfaced with control, and data collection modules throughout the mill monitor and control management input and output data including diagnostic and quality control data.

This management computer is not directly controlling the machines. It is a single source management control because it is the direct link between machine and management outputting information programmed for management's particular needs in the form of graphs, tables reports, warnings transmitting to the individual machine centres revised instructions for specific machines and operators.

Needless to say, the well designed system would not be churning out masses of data but presenting only the essential facts required by the enquirer; the shift operating supervisor receiving what he needs to know, or the maintenance foreman, or saw-filer, or production manager each scanning and/or controlling his own and free to assess, think and act in total relationship to the whole process.

Although not shown here, other important links and this can all be built up progressively would be to include:

- Quality control: scanners monitoring sizes at any machine centre, ensuring immediate recognition and correction of mismanufacture.
- Market information, sales orders, values.
- Inventory status, sales orders, log purchases, controlled and integrated with production.

Monitor Systems

Another system designed to monitor and analyze production is typified by this example. Each machine

centre can have an operator monitor. All monitors are inter-connected to a central computer and there can be various terminals.

The machine centre monitor receives information from sensors identifying specific facts like feed speeds, piece counts, delays, etc. Superimposed on these are operator inputs. For example, a delay of more than a predetermined amount causes a signal to the operator to input a downtime cause. Communications to and from the operator are incorporated.

This system is intended to be most specifically configured for every individual operation and analysis is a key feature.

For example, trends resulting from certain cutting breakdowns may, by analysis, indicate that certain circumstances or particular log sizes for example result in production slow-downs at some related key machine centre. Therefore, a different manufacturing strategy may be called for, or a machinery change justified.

Again, masses of output must be avoided so that the different levels of management get to see what they need to know for their particular needs, tailored for their own plant. For example, a different report and different information can be made available for the maintenance department, production superintendent, quality control supervisor, manager and other personnel.

Production Simulation

There are a number of programs available which can simulate or model, for the sawmill manager or designer, the various production aspects of his process. Some relate to the sawing process only.

Some are largely comprehensive models of his own plant and many are quite user-friendly. Accurate and easy-to-use models can be constructed which operate virtually the same as his own operation. With these programs it is possible for him to blend in with his existing log mix, for example a new log purchase he may be contemplating, then flow it through his mill.

The headrig in his computer model would cut at speeds depending on depth of cut for his own log sizes, generating various pieces for the different machine centres, summarizing yields in dimensions and grades, calculating sales based on market values, totalling the operating costs of all important cost centres providing an overall cost analysis identifying production limitations.

All this done without the manager leaving his desk, leaving him free to think and conceive.

These next examples are from a user-friendly inter-active and self-teaching program. The user has only to respond to simply stated requests and replies with a simple stroke; he doesn't have to be a typist. No computer jargon is involved. The instructions are always screened but he can quickly flash by when he is familiar (Figure 4).

Programs like this give him easy but comprehensive ways to survey his plant and his options. In this example he is seeking information on how his plant would respond to a particular production simulation. By pressing "A" he can look at his log supply, and "H" will let him see the condition of his machine centres. Not difficult, just type an "H" and he immediately sees this:

Any time he can easily re-run the whole model changing all the variables at his command running extra shifts, using alternative breakdown strategy, trying other log mixes until he has determined the optimum production plan.

Incidentally, if he wants to examine a machine he not only can see how it is affected by a particular production loading but he can review its vital characteristics: feed speeds, saw sizes, etc.

Quality Control

Quality control programs are starting to bring under increasing management comprehension all the vital quality control aspects. Especially worthy of note is the extremely practical Lumber Size Control program pioneered and made available to the sawmill industry by Forintek (Fig. 5). This program conducts a sawmill through an accurate evaluation of its sawing accuracy and establishes realistic target sizes for specific machinery and maintenance standards.

It monitors their progress and keeps them on track. It has the potential to relate inaccuracies to specific maintenance routines, tying in with saw-filing, preventive maintenance, etc.

Other Programs

Other programs either available or developing will enable management staff to monitor and control such functions as:

- Maintenance management
- Log and lumber inventory
- Shipping procedures such as railcar loading
- Mill modification planning
- Operator training and evaluation
- Personnel considerations

I hope that I have been able to outline not only the opportunity we can look forward to in the future, but also those that are available now to bring about

productivity improvement and bring all the benefits of increased productivity to industry, workers and

society who need productivity improvement to avoid unemployment.

*

*

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Figure 1

THE MIND

log supply
machines
people
markets • profit

THE COMPUTER

user-friendly
inter-active
self-teaching

Combine to:

- liberate from routine and detail
- process information
- provide options

Assist in:

- decision making
- monitoring results
- adapting
- controlling

Resulting in:

- productivity improvement

Figure 2

Typical Programs Integrating Machine and Management:

- Production simulation
- Total mill networks
- Production monitoring
- Lumber size analysis
- Other quality control programs
- Maintenance management
- Log and lumber inventory
- Shipping procedures (railcar loading, etc.)
- Mill modification planning
- Operator training and evaluation
- Personnel considerations

Figure 3.



Figure 4

SAWMILL PRODUCTION SIMULATION
(prepared by Adam Ferrie & Associates Ltd.)

This program consists of a series of linked programs which receive logs in various characteristics and volumes, process them through the sawmill and produce lumber, residuals and revenue projections.

Instructions

- Anytime you want to move on, press the space-bar.
- The results of the program will be printed at the appropriate times but if you want a print of any other screening for reference, press "?".
- If you want to back track at any time press "?".
(Backtracking will take you to this screening, so you then keep pressing "space-bar" to get you to where you want to be. All your work will have been retained in its last form of entry.)
- To cancel everything and start again press "Reset".
- Press "space-bar" to continue.

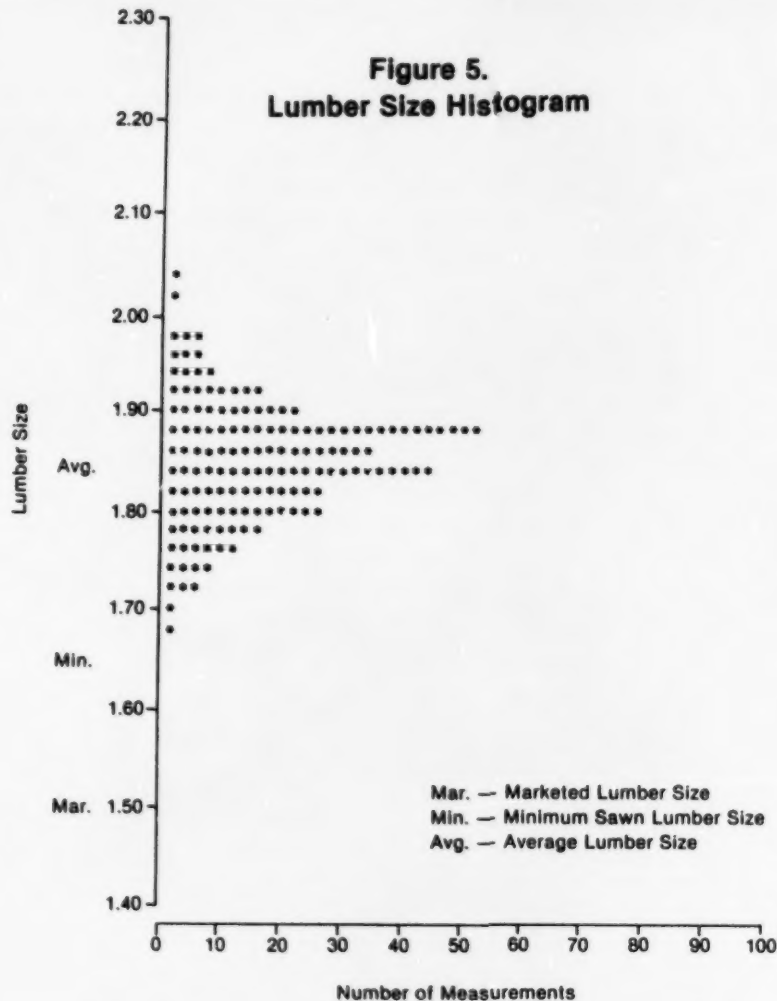


Figure 6
SAWMILL PRODUCTION SIMULATION
(prepared by Adam Ferrie & Associates Ltd.)

Machine Centre Record and Operation

Machine	Loading (Current Simulation)
1. Small Log Processor	Acceptable
2. Large Log Cut-off Saw	Acceptable
3. Large Debarker	Acceptable
4. Medium Debarker	Acceptable
5. Small Debarker	Acceptable
6. Bandmill and Carriage	Acceptable
7. 10" Chip-N-Saw	Acceptable
8. 8" Chip-N-Saw	Acceptable
9. Cant Gang Saw	Acceptable
10. Board Edger	High
11. Reman Edger	Acceptable
12. Trimmer	Acceptable
13. Sorter	Acceptable

Question Period

Question

I have a question for George Payette. You alluded to problems that you had in terms of getting electronic technicians to work with your maintenance or process control equipment and another comment elaborated further on dealing with that problem. I would like to know what position did you take? You seem to have overcome the problem but I did not understand how.

Answer (George Payette)

Electronic technicians have not been that much of a problem for Eddy Forest Products. We developed our own because we started from square one, with a rather simple electrical control, and went from there to simple electronic control and on to quite a sophisticated electronic control.

I said that we were having trouble finding a hydraulic technician. I think we have managed quite well electronically. We have a couple of electricians who can actually sit down and write a program for a programmable controller now, when they did not even know what a programmable controller was two years ago. But hydraulics is so sophisticated and so complex that I have a real problem as to how I am going to maintain it. Our own millwrights have taken the apprenticeship program and have graduated as full-fledged millwrights but have only taken a smattering of hydraulics; they really don't know hydraulics from page two when they get right down to it.

I showed you a picture of only one hydraulics room. We have installed about \$1,500,000 worth of hydraulics in the last six months. In hydraulic power packs alone, we are up over \$500,000 and then you turn around and add the manifolds and the hydraulic motors and everything else that goes along with it, it is a very, very complicated arrangement, equally as complicated as electronics.

The trouble is that nobody has been trained to handle complicated hydraulics, except perhaps a graduate engineer. I don't know if I have answered your question but that's it; electronics is not our problem, hydraulics is.

Question

I have a question for Graham Wray. Regarding the last management program you were talking about at H.A. Simons and Adam Ferrie. Is that program now available or is that still under development and what is the current status.

Answer (Graham Wray)

That program is a development of design programs that we have been using for a good few years to conceive and simulate some production flow so it has been utilized by the designer up until right this present moment. Now we are remodeling it so that it will respond to specific mills and it is in an advanced stage of development. I would think that in a few more weeks we would be able to show it in the way that we intend to make it available.

Question

I would like to address a question to Mr. Schuler. He indicated that our production costs would be going up two to three per cent plus whatever inflation we would have, compared to something less than one per cent in the U.S. and Sweden. Can he outline where our major differences lie? How are we achieving these high figures as opposed to the U.S.?

Answer (A. Schuler)

There are a couple of reasons that our total production costs are projected to increase at about a real rate of two to three per cent compared with less than one in the U.S. and zero in Scandinavia. Primarily, our

delivered wood costs are getting much higher than those in Scandinavia and the United States. This is due primarily to the fact that Scandinavia, the United States and several other countries have had very intensive forest management programs for some 20 years now. Canada is still just thinking about when they are going to run out of old growth, and we have not spent very much money on intensive forest management relative to the rest of the world. Scandinavia has been cutting second growth forest for a long time; in fact, over 60 per cent of all the commercial forest in Finland is plantation forest.

In the U.S. southeast, they are talking about cutting third growth forest in another ten or fifteen years. They have been working on second growth for some time. So, one reason is our delivered wood costs are going to be quite a bit higher because we have to go further and further for a lower quality resource.

We will have to make a very difficult transition in basing our forest product industry on second growth forest and moving from an old growth forest-based technology. That is going to take some time because we just don't have the second growth right now. We are only just starting to manage our forest anywhere near as intensively as the rest of the western world. So our delivered wood costs will be higher for sure.

There are some other reasons. If you look at wage rate settlements in Canada versus the U.S. for the last three or four years, particularly in forest products, our settlements are running much higher than they are in the U.S., particularly the northwest. Another reason is the labor problem that we have up here, that they don't seem to have to the same degree in other countries. However, I think the major reason is going to be delivered wood costs.

We have been the leader as far as having an abundance of softwoods in the past and this was not any problem when the rest of the world did not have the softwood. But now, as I mentioned before, the gap between supply and demand, particularly for softwoods, has been closed essentially. That means the low cost producer in the future is going to be the one that is going to maintain market share, to get into new markets and expand overall market share.

We will have to be able to convert a lower quality and smaller raw material for the next 25 years, at least until our second growth forests are mature. This is why we are going to have to spend more on productivity improvements than some of the other countries, or else our forest products industry is not going to be in very good financial condition when we do have the raw material to compete on a delivered wood cost basis. But to answer your question, I think it is primarily delivered wood costs, but we do have some serious labor management problems.

Question

Has Forintek looked at the long term in the sense that if we do go into more intensive forest management, can we project a relatively reduced wood cost in 15, 20, 30 years time. In other words, have we looked into the potential rate of return of intensive forest management in certain areas.

Answer (Al Schuler)

We have to look at that sort of a question to help guide our research programs certainly, but I don't see any reason why Canada can't have delivered wood costs in line with the rest of the western world if we start managing forest land as intensively. We must use technology, genetic tree improvements, and some of the other intensive forest management practices and also increase our utilization.

Right now we still leave about 40 to 50 per cent of the tree in the woods, and of the logs that we bring to the mill we only convert roughly 50 per cent into high value final products. I don't see any reason why we can't bring our delivered wood costs down if we start practising intensive forest management and we will have to, because of delivered wood costs. Wood costs as a percentage of total manufacturing costs to the plywood people in the West Coast are over 50 per cent now and for some places it is as high as 80 per cent.

In the case of lumber across North America, the cost of the wood relative to total manufacturing costs is somewhere between 40 and 50 per cent, and in certain parts it is over 50 per cent. It is a key production cost that we have to get under control.

Question

I have a question for Bill Love that I would like to have clarified. Did I understand correctly that with the log 6.4 inches in diameter, and 12feet long, if we had the best opening face, we could recover 24 fbm. I think that was on your chart and I wondered if I was understanding that correctly or not.

Answer (Bill Love)

Yes, the log that I showed was 6.4 inches in diameter and it was 12feet long with two inches of taper, and we used the best opening face program to break it down. It should yield, if the log is sound and straight, 27 fbm, but as Mr. Payette showed you we have a line which is a theoretical optimum, then we should have a line that is realistic when we start to consider all the things that we are going to have like some sweep and crook. Somebody has to edge it and somebody has to trim it. I don't think it is unusual to have a lot of mills that run between an LRF of 5.8 to say 6.4. So if you wanted to optimize your edging and your trimming,

minimize your lumber size I would think that yes, somebody might be able to get 27 fbm out of a 6.4inch log, 12 feet in length.

Question

That is unclear in my mind, but what would be the shortest piece that you might end up with if you were able to do that, the shortest and the narrowest.

Answer (Bill Love)

The BOF sawing solution only considered a minimum width of threeinches and a length of eight feet.

Question

If you had a computer control headrig and you had a limited amount of money and you wanted to spend it at the edger or the trimmer in the form of an optimizer, which would you pick?

Answer (George Payette)

The trimmer.

* * *

Forintek Canada Corp.

Canada's National Wood Products Research Institute

Established in 1979 as a private, non-profit corporation. Forintek is funded from contract research work, industry support, and government grants and contributions. The staff of 200 is about equally divided between its Western Laboratory in Vancouver and its Eastern Laboratory in Ottawa. The corporate office is located at Vancouver, at the Western Laboratory.

A key element in the operation of Forintek is industry involvement in its research programs. This is accomplished through Research Program Committees and a Board of Directors which consist largely of senior representatives from industry, as well as representatives from federal and provincial governments. It is through these forums that a means is established for industry to have strong input into Forintek's operation, program planning and assessment.

By responding to industry's research needs directly, Forintek plays a vital role in solving technical problems and helping the Canadian wood products industry maintain its competitive position in world markets.

"Productivity improvement" is a common objective for industry and government alike. Accordingly, the federal Department of Industry, Trade and Commerce and Regional Economic Expansion is financing a series of seminars addressing productivity improvement through electronic-based technology. Forintek Canada Corp. will be presenting these seminars on behalf of the federal government during 1983 and 1984.

Enquiries relating to Forintek's services and seminars may be directed to:

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